REMARKS

Claims 1 to 9, 20 to 31, 33, 35 to 43, 54 to 70, and 80 to 88 are pending in the application, of which claims 1, 20, 25, 28, 33, 35, 54, 59, 62, 81 and 86 are independent. Favorable reconsideration and further examination are respectfully requested.

All of the claims were rejected in the Office Action. Solely to advance prosecution, and without conceding the propriety of their rejection, Applicant hereby cancels claims 10 to 19, 32, 34, 44 to 53, and 71 to 80. Of the remaining claims, claims 1 to 9, 28 to 31, 33, 35 to 43 and 62 to 70 were rejected under 35 U.S.C. §102(b) over U.S. Patent No. 4,992,998 (Woodward); claims 20 to 24, 54 to 58 and 81 to 85 were rejected under §102(b) over U.S. Patent No. RE31,509 (Neidell); and claims 25 to 27, 59 to 61 and 86 to 88 were rejected under §102(b) over U.S. Patent No. 4,470,048 (Short). As shown above, Applicant has amended the claims to define the invention with even greater clarity. Reconsideration and withdrawal of the rejections are respectfully requested.

Amended independent claim 1 defines a method which includes transmitting a sound wave comprised of a first portion and a second portion, the first portion comprising a pulse signal and the second portion comprising a ring-down signal, obtaining a characteristic of the second portion, storing the characteristic, using the characteristic to detect an echo of another sound wave, and repeating transmitting, obtaining, storing and using periodically for different sound waves and corresponding first and second portions.

The applied art is not understood to disclose or to suggest the foregoing features of claim 1. In particular, Woodward is not understood to disclose or to suggest at least

obtaining a characteristic of a ring-down (second) portion of a sound wave and using the characteristic to detect an echo of another sound wave.

More specifically, Woodward describes detecting echoes of acoustic energy according to the algorithm of Fig. 2, i.e., removing narrow echoes, reforming fragmented echoes, forming a time varying threshold, and applying the ALF algorithm. When forming the time varying threshold, the Woodward process discounts the effect of the ring-down portion of the initial signal. More specifically, as shown in step 7 of Fig. 5, an arbitrarily high value replaces the ring-down portion of the transducer signal (see also column 9, lines 28 et seq. of Woodward). Thus, unlike the invention of claim 1, Woodward does not obtain a characteristic of a ring-down portion of a sound wave and use the characteristic to detect an echo of another sound wave. Accordingly, claim 1 is believed to be patentable.

Amended independent claim 35 is an apparatus claim that performs the method of claim 1; and amended independent claim 62 is a computer program claim that performs the method of claim 1. These claims are believed to be patentable for at least the same reasons noted above with respect to claim 1.

Amended independent claim 20 defines a method which includes transmitting a signal, receiving a first echo in response to the signal, and receiving a second echo in response to the signal. If an amplitude of the first echo exceeds a corresponding amplitude of the second echo, then the second echo is determined to be a multipath error from a single object. If an amplitude of the second echo exceeds a corresponding amplitude of the first echo, then the first and second echoes are determined to be from first and second objects, respectively. In this latter case, the method further includes using the first echo to

determine information relating to the first object, and using the second echo to determine information relating to the second object.

The applied art is not understood to disclose or to suggest the foregoing features of claim 20. In particular, Neidell is not understood to disclose or to suggest at least determining a multipath error if a first echo exceeds a corresponding amplitude of a second echo and determining first and second objects if an amplitude of the second echo exceeds a corresponding amplitude of the first echo.

More specifically, Neidell describes a method of identifying a reflecting target in terms of parameters such as target range, echo velocity, and angular information. Only the embodiment show in Fig. 10 shows more than one reflecting object (see column 19, lines 16 et seq.). In the embodiment of Fig. 10, all three reflecting targets return an echo signal. There is no determination regarding whether the echoes are multipath error or for actual objects, much less doing so based on amplitudes of first and second echo signals. Accordingly, claim 20 is believed to be patentable.

Amended independent claim 54 is an apparatus claim that performs the method of claim 20; and amended independent claim 81 is a computer program claim that performs the method of claim 20. These claims are believed to be patentable for at least the same reasons noted above with respect to claim 20.

Amended independent claim 25 defines a method that includes transmitting a waveform having a predetermined shape, receiving a signal, analyzing a shape of the signal, and determining if the signal comprises an echo of the waveform based on analysis of the shape of the signal and the waveform having the predetermined shape.

The applied art is not understood to disclose or to suggest the foregoing features of claim 25. In particular, Short is not understood to disclose or to suggest at least determining if a signal comprises an echo of a waveform based on analysis of the shape of the signal and the waveform having the predetermined shape.

More specifically, Short describes identifying targets based on their echoes. In Short, echoes are obtained from objects and compared to pre-stored profiles in order to identify those objects (see, e.g., Fig. 1, column 1, lines 17 to 44, and column 4, lines 13 to 27 of Short). Thus, while Short describes identifying an object based on an echo signal and a pre-stored profile, Short does not described determining if a signal is an echo of a waveform based on an analysis of the waveform itself. For at least this reason, claim 25 is believed to be patentable.

Amended independent claim 59 is an apparatus claim that performs the method of claim 25; and amended independent claim 86 is a computer program claim that performs the method of claim 25. These claims are believed to be patentable for at least the same reasons noted above with respect to claim 25.

Amended independent claim 28 defines a pulse-echo sonar scanner for a mobile robot. The pulse-echo sonar scanner includes a transmitter which generates a pulse signal, an acoustic transducer which transmits and receives acoustic signals, a receiver, and means for determining performance characteristics of the transducer periodically during operation of the pulse-echo sonar scanner for a given pulse. The performance characteristics of the transducer comprise transducer ring-down. The pulse-echo sonar scanner also includes

means for storing the performance characteristics, and means for determining threshold levels for an echo signal based on the stored performance characteristics.

The applied art is not understood to disclose or to suggest the foregoing features of claim 28. In particular, Woodward is not understood to disclose or to suggest at least determining performance characteristics of the transducer periodically during operation of the pulse-echo sonar scanner for a given pulse, where the performance characteristics of the transducer comprise transducer ring-down, much less means for determining threshold levels for an echo signal based on the performance characteristics. In more detail, as noted above, Woodward discounts the effect of the ring-down portion of the transducer signal when identifying echoes. Accordingly, Woodward could not possibly include the foregoing features of claim 28 and, therefore, is believed to be patentable.

Amended independent claim 33 defines a method of adjusting threshold levels on a mobile robot scanner. The method includes measuring ring-down characteristics of the mobile robot scanner periodically during operation of the mobile robot scanner, creating a dynamic threshold level based on the ring-down characteristics, and applying the dynamic threshold levels to received signals.

The applied art is not understood to disclose or to suggest the foregoing features of claim 33. In particular, Woodward is not understood to disclose or to suggest at least creating a dynamic threshold level based on the ring-down characteristics, and applying the dynamic threshold levels to received signals. As noted above, Woodward discounts the ring-down portion of the transducer and, thus, does not use ring-down characteristics to create a dynamic threshold level. Claim 33 is therefore believed to be patentable.

The remaining art of record has been reviewed and is not believed to add anything that would remedy the foregoing deficiencies of the applied art. Accordingly, the entire application is believed to be in condition for allowance, and such action is respectfully requested at the Examiner's earliest convenience.

Applicant's undersigned attorney can be reached at the address shown below. Telephone calls regarding this application should be directed to the undersigned at 617-521-7896.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

--1. (Amended) A method comprising:

transmitting a sound wave comprised of a first portion and a second portion, the first portion comprising a pulse signal and the second portion compring a ring-down signal;

obtaining a characteristic of the second portion;

storing the characteristic; [and]

using the characteristic to detect an echo of another sound wave; and

repeating transmitting, obtaining, storing and using periodically for different sound waves and corresponding first and second portions.

2. (Amended) The method of claim 1, wherein [the first portion comprises a pulse signal and the second portion comprises a ring-down signal,] the ring-down signal comprises [comprising] a signal that decays in amplitude over time.

20. (Amended) A method comprising:

transmitting a signal [towards two objects, a first of the objects being in front of a second of the objects];

receiving a first echo in response to the signal [from the two objects]; and

receiving a second echo in response to the signal [from the two objects];

wherein if an amplitude of the first echo exceeds a corresponding amplitude of the second echo, then the second echo is determined to be a multipath error from a single object; and

wherein if an amplitude of the second echo exceeds a corresponding amplitude of the first echo, then the first and second echoes are determined to be from first and second objects, respectively, and [wherein, if the second echo is comprised of an amplitude having a greater amplitude than the first echo,] the method further comprises:

using the first echo to determine information relating to the first object; and

using the second echo to determine information relating to the second object.

25. (Amended) A method comprising:

transmitting a waveform having a predetermined shape;

receiving a signal;

analyzing a shape of the signal; and

determining if the signal comprises an echo of the waveform based on [the] analysis of the shape of the signal and the waveform having the predetermined shape.

28. (Amended) A pulse-echo sonar scanner for a mobile robot, comprising:

a transmitter which generates a pulse signal;

an acoustic transducer which transmits and receives acoustic signals;

a receiver;

means for determining performance characteristics of the transducer periodically during operation of the pulse-echo sonar scanner for a given pulse, the performance characteristics of the transducer comprising transducer ring-down;

means for storing the performance characteristics; and

means for determining threshold levels for an echo signal based on the stored performance characteristics.

33. (Amended) A method of adjusting threshold levels on a mobile robot scanner, comprising:

measuring ring-down characteristics of the mobile robot scanner periodically during operation of the mobile robot scanner;

creating a dynamic threshold level based on the ring-down characteristics; and

applying the dynamic threshold levels to received signals.

35. (Amended) An apparatus comprising:

a transducer which transmits a sound wave comprised of a first portion and a second portion, the first portion comprising a pulse signal and the second portion compring a ring-down signal; and

a processor which obtains a characteristic of the second portion, stores the characteristic, [and] uses the characteristic to detect an echo of another sound wave, and repeats obtaining, storing, and using periodically for different sound waves and corresponding first and second portions.

36. (Amended) The apparatus of claim 35, wherein the [first portion comprises a pulse signal and the second portion comprises a ring-down signal, the] ring-down signal comprises [comprising] a signal that decays in amplitude over time.

54. (Amended) An apparatus comprising:

a transducer which transmits a signal [towards two objects, a first of the objects being in front of a second of the objects];

a receiver which receives a first echo [from the two objects] and a second echo in response to the signal [from the two objects]; and

a processor which compares amplitudes of the first and second echoes [determines if the second echo is comprised of an amplitude having a greater amplitude than the first echo];

wherein if an amplitude of the first echo exceeds a corresponding amplitude of the second echo, then the processor determines that the second echo is a multipath error from a single object; and

wherein if an amplitude of the second echo exceeds a corresponding amplitude of the first echo, then the processor determines that the first and second echoes are from first and second objects, respectively, and [wherein, if the second echo is comprised of an amplitude having a greater amplitude than the first echo,] the processor:

uses the first echo to determine information relating to the first object; and

uses the second echo to determine information relating to the second object.

59. (Amended) An apparatus comprising:

a transducer which transmits a waveform having a predetermined shape;

a receiver which receives a signal; and

a processor which analyzes a shape of the signal, and determines if the signal comprises an echo of the waveform based on [the] analysis of the shape of the signal and the waveform having the predetermined shape.

62. (Amended) A computer program stored on a computer-readable medium, the computer program comprising instructions that cause a processor to:

obtaining a characteristic of a second portion of a sound wave comprised of a first portion and a second portion, the first portion comprising a pulse signal and the second portion compring a ring-down signal;

store the characteristic; [and]

use the characteristic to detect an echo of another sound wave; and

repeat transmitting, obtaining, storing and using periodically for different sound waves and corresponding first and second portions.

63. (Amended) The computer program of claim 62, wherein the [first portion comprises a pulse signal and the second portion comprises a ring-down signal, the] ring-down signal comprises [comprising] a signal that decays in amplitude over time.

81. (Amended) A computer program stored on a computer-readable medium, the computer program comprising instructions that cause a processor to:

cause a signal to be transmitted [towards two objects, a first of the objects being in front of a second of the objects];

receive a first echo in response to the signal [from the two objects]; and

receive a second echo in response to the signal [from the two objects];

wherein if an amplitude of the first echo exceeds a corresponding amplitude of the second echo, then the second echo is determined to be a multipath error from a single object; and

wherein if an amplitude of the second echo exceeds a corresponding amplitude of the first echo, then the first and second echoes are determined to be from first and second objects, respectively, and [wherein, if the second echo is comprised of an amplitude having a greater amplitude than the first echo,] the computer program provides for:

using the first echo to determine information relating to the first object; and

using the second echo to determine information relating to the second object.

86. (Amended) A computer program stored on a computer-readable medium, the computer program comprising instructions that cause a processor to:

cause a waveform having a predetermined shape to be transmitted;

receive a signal;

analyze a shape of the signal; and

determine if the signal comprises an echo of the waveform based on [the] analysis of the shape of the signal and the waveform having the predetermined shape.--